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THE WAY FORWARD IN CHEMISTRY[1]

By WILLIAM ALBERT NOYES

UNIVERSITY OF ILLINOIS

SOME years ago Professor Lewis published an article on "Two-way Time," based on the principle of relativity. Instead of the older idea that time progresses only in one direction—forward—he expressed the thought that time is an inseparable whole. In terms of relativity time is a fourth dimension correlated to the three dimensions of space.

I shall not attempt to discuss the mathematical aspects of this question. I am quite incompetent to do that. I wish to emphasize the fact that the future is of far greater interest to us than the past and should have a greater influence on our conduct. I shall speak of the past this afternoon only as it has a relation to the future.

I think I may be pardoned for a reminiscence. When I graduated from Grinnell College, somewhat more than fifty years ago, it was customary for graduates to give short "orations" on commencement day. I chose for my topic "The Unity of Force." It should have been "The Unity of Energy," but the mistake in nomenclature may perhaps be excused in a young bachelor of that period. My thought was that all forms of energy consist in the motion of material substances, sometimes taking the form of the motion of large bodies, at other times the motion of atoms or molecules, but, whatever its form, capable of being transformed in some definite manner into the sort of motion expressed in some other form of energy. My thought at the time was that there are two fundamental entities in the universe, matter and energy.

The twentieth century has broadened and simplified our concept. We now think of a single entity which we may call matter or energy, since each may be transformed into the other.

[1] An address delivered at San Francisco on August 19, 1935, on receiving the Priestley Medal of the American Chemical Society.

A similar change has occurred in our chemical concept of matter. We then thought of all material substances as composed of about eighty different kinds of particles, each of its own special sort, and that the transmutation of one of these into another was impossible. A noted astronomer spoke of these atoms as "manufactured articles." Now we place no limit to the possibilities of transmutations, and as the ultimate constituents of matter we recognize electrons, positrons, protons (or neutrons) and photons. The last are of an infinite variety and may be spoken of as in some sense the connecting link between matter and energy.

I do not present these ideas as a final and complete concept of the structure of the universe but as a rough outline of the direction in which our thoughts have changed during fifty years. The surprising thing is not that the changes have been so great, but that our present thoughts contain so much that is old. The changes have been by evolution and addition rather than by revolution. Revolution discards what is old and wishes to build entirely new.

During the middle ages a philosophy called "Holism" was prevalent. This philosophy thought of God as the center of the universe and of the Bible and the church as His infallible interpreters.

There is growing before our eyes a new "Holism," for which the plain common sense which we call science furnishes the background. We have abandoned the idea that we can find an infallible guide, but we have a conviction that science may give us a reliable basis for the interpretation of the best knowledge that we can get. It will lead our way to the truth which should guide our conduct. It will do this for all questions which concern our intellectual lives, not only in regard to the so-called material universe, where scientific methods are already supreme, but also, more and more, in social, national and international relations. One of the most important characteristics of this method is that the individual endeavors to free himself from all personal and national prejudices. We recognize the value of such a spirit in dealing with international relations. It is the indispensable foundation for justice in all our affairs.

If what has been said is true, we shall see that the way forward in chemistry is not that we shall think of it as an isolated branch of science and as independent of the rest of our lives. The days when isolation and "rugged individualism" were appropriate are passed. We must always retain the units of which the whole is made and must provide for the development of personality and initiative. We should permit freedom of opinion and avoid regimentation. But we must also restrain the individual who will not contribute his share in cooperative service and we must stop the person or nation that wishes to exploit others.

During the nineteenth century England was well satisfied that she was separated from the continent by the ocean and that her powerful navy was a protection against attack. She received a rude shock when she found that a cargo of wheat from Argentina could be "spurlos versunken" in mid-ocean, that London could be bombarded from the air, and that a "Big Bertha" in Germany could bombard Paris. A British statesman has recently said that England's boundary is now the Rhine, and England realizes that her safety no longer lies in her navy but must depend on cooperative action of the nations of the world against an aggressor. The United States is no more isolated by the Atlantic Ocean to-day than England was by the English Channel a century ago.

The two outstanding problems to be solved by our generation are the abolition of war and a better distribution of work and the products of our industries. We have no right to bury ourselves in chemistry and think we are under no obligation to contribute our share to the solution of these problems. The scientific men of the world have done their full share toward solving the problems of production and of health. We have immensely increased the fertility of our soils, we have furnished beautiful dyes for our clothing, we have made artificial silk from cotton and have provided thousands of new materials not available twenty-five years ago.

There can be no doubt that America and the nations of Western Europe are abundantly able to furnish work and a reasonable standard of life for all their people. It is absurd that during the last fifteen years millions of men and women have been unemployed and dependent on "relief." We as chemists should do our part in the solution of this problem.

We have done better, though by no means too well, about health. The expectation of life for a baby born to-day is more than double that of seventy-five years ago.

In 1906 steps were taken to organize *Chemical Abstracts*. Learning from the experience of the German Chemical Society, we increased our dues and required all members of the society to contribute to the support of the new journal. Avoiding the mistake of the English chemists, *Chemical Abstracts* included both industrial abstracts and those giving an account of researches in non-industrial fields. As a result of these two policies, we have succeeded in holding all classes of chemists together in a single society.

Before *Chemical Abstracts* was well established, financially, we discovered that the industrial chemists felt that their interests were not well cared for and that some of them were considering the organization

of a separate society. At one time the English Society of Chemical Industry had 1,500 members in its New York Section. From a financial point of view the time was not opportune, but it was decided to increase the dues again and establish our *Industrial Journal*. Partly because of the policy of our society to care for all classes of chemists, but also, in no small measure, because of the splendid organizing ability of our secretary, Professor Parsons, it has been possible to carry on almost entirely on the basis of our membership dues and the income from advertising in our journals.

During the earlier years following the expansion of our functions as a society our success depended largely on the membership dues paid by all our members. When costs of paper, printing and postage became a larger proportion of the cost of issuing our journals, it was possible to introduce a new policy. An initial payment of $9.00 is required from all members to pay for the general expenses of the society and a part of the cost of editorial services and of putting the journals on the press. Each member receives a copy of the News Edition of the *Industrial Journal* and may receive *Industrial and Engineering Chemistry* or the *Journal of the American Chemical Society* for $3.00 or *Chemical Abstracts* for $6.00. From $10.00 to $25.00 would have to be paid for similar journals published anywhere else in the world. This arrangement has been in effect long enough to demonstrate that it is financially possible.

At the present time there is a rather strong feeling on the part of some of our members, especially on the part of those interested in organic chemistry, that we do not provide adequately for the publication of researches of a non-industrial character. This has gone so far as to lead to a proposal to start a *Journal of Organic Chemistry*. The policy followed in connection with our other journals indicates another solution of this problem as possible. The *Journal of the American Chemical Society* might be divided into two parts. One part would be devoted to inorganic and physical chemistry and the other to organic and biological chemistry. If members who subscribed for either part were to pay $3.00 and those subscribing for both, $5.00, a sufficient sum might probably be secured to pay for the additional space needed. A canvass of all who now receive the *Journal of the American Chemical Society* would probably give reliable information about the possibility of such a proposition.

I am submitting this proposition, personally, as one who edited the *Journal of the American Chemical Society* for seventeen years, took an active part in organizing both *Chemical Abstracts* and the *Industrial Journal*, and arranged for the incorporation of the *American Chemical Journal* in our journal. I think the question should be carefully considered and adopted or modified in accordance with the wishes of the 10,000 individuals and organizations who now subscribe for the journal.

We organized *Chemical Abstracts* on the basis of an increase of $3.00 in the dues and a subscription list of about 3,000. The *Industrial Journal* was organized with an increase of $2.00 and a slightly greater subscription list. If the present subscription list were divided equally between the two journals there would be 5,000 for each and certainly some additions, because some would take both journals. I firmly believe that we have the opportunity to establish a very important *Journal of Inorganic and Physical Chemistry* and also a very important *Journal of Organic and Biological Chemistry*. The success of the journals, if established, will depend, however, not on their subscription lists but on the research work of American chemists, which is giving them high rank among the chemists of the world.

In correspondence with Professor Lamb, chairman of a Committee of the Directors of the Chemical Society which is considering the possibility of dividing the *Journal of the American Chemical Society*, he objects that it is not desirable to carry specialization too far. With this objection I am in hearty sympathy and I have made the following alternative suggestion:

The papers in the journal are already divided into two classes. The first class of papers might be published on the 5th of each month, with the heading, *Journal of the American Chemical Society* and subheading, *General, Physical and Inorganic*, with which is incorporated the *Journal of Physical Chemistry*, founded by Wilder D. Bancroft. The second class of papers would be published on the 25th of each month with the heading, *Journal of the American Chemical Society*, with the sub-heading, *Organic and Biological*. The pagination of the two parts should be continuous, and a single index would be issued for the two parts.

An editor for the first part should be nominated by the Division of Physical and Inorganic Chemistry and the Division of Colloid Chemistry and an editor for the second part nominated by the Division of Organic Chemistry and the Division of Biological Chemistry. The elections should be by the council of the society, of course.

The additional expense might be covered by making the subscription, to members, $4.00. It may be remembered, however, that when the Analytical Edition was separated from *Industrial and Engineering Chemistry* the expense was borne by the general budget of the society.

We all know that non-industrial research lies at the basis of our industries. It was Faraday and not Edison who laid the foundation for the development

of our electrical industries. It is certainly an important function of our society to provide adequately for the publication of such research.

I have emphasized the fact that chemistry is not an isolated science with sharp lines separating it from physics and biology or even from economics, sociology and political science. We should see clearly that we live in surroundings that are, in reality, a *universe,* in which each part has relations with every other and that we ignore these relationships at our peril. This knowledge should have a profound effect both on general education and on the way in which we train men to be chemists.

In spite of the simplification and unification of the foundations of our knowledge, the detailed information in each branch of science has increased tremendously and tens of thousands of men and women are eagerly engaged in extending the boundaries of science. One needs only to look at the annual index of *Chemical Abstracts* to realize that the detailed knowledge available to chemists to-day far exceeds that available in all science fifty years ago. No individual can possibly gain a comprehensive acquaintance with any branch of science. Every chemist knows that he often needs to use some fact far afield from his special domain. It becomes daily more evident that any attempt to gain a comprehensive knowledge of a particular science, such as chemistry, or of science as a whole, is futile. Instead of that we must endeavor to give all students a broad knowledge of the heritage available to those who know how to use it.

Fifty years ago we had a book called "Fourteen Weeks in Chemistry." Many scientific men thought such a book quite useless, but some who studied in academies and colleges in those days got a better acquaintance with the universality of science than is gained to-day by a more specialized training in one or two branches of science.

I wish to say a few words about the early training of a child and the relation of this to the training of a chemist.

The first lessons of the child are in practical sociology. These must necessarily be in the home or sometimes through a poor substitute furnished by an institution. Professor Ralph S. Lillie, in a paper read before the Chaos Club in Chicago and published in the *American Naturalist* in 1934, has stated two of the most fundamental laws of the universe which every child learns, in part, before he is four years old.

(1) We live in a stable and reliable environment in which consequence follows antecedent with an almost inexorable certainty.

(2) We may, in very large measure, so adjust ourselves to our environment as to make it serve us.

Professor Lillie characterized these laws as the principle of stability and the principle of change.

Not every one accepts the second principle, philosophically, but I know of no one who does not act on it practically. Without it, education would be useless. Without it, the human race would be in nearly the same condition in which it lived for hundreds of thousands of years before a written language was invented.

The early years in school are necessarily given to instruction in the "three R's" to furnish the child with the tools which unlock for him the storehouse of knowledge. Parallel with this he learns further lessons in sociology and in other things, on the playground and in the mingling with other children. In Heidelberg, four years ago, we learned that all German children attended the same schools for the first four years and that private schools for these grades were not permitted. This secured a mingling of the children which seems desirable in a democracy, if the classes are not too heterogeneous.

During the first six years of school the studies for all children should be essentially the same, but the classes should not be so crowded as to prevent the teacher from studying the personal characteristics of individuals and adapting the instruction to suit each.

The segregation of the seventh, eighth and ninth grades as a "junior high school" is giving an opportunity which has not yet been fully utilized. It has been found that capable pupils can accomplish the scholastic work of the seventh and eighth grades in a single year and it is evident that such pupils will waste their time and acquire bad habits of study, or lack of study, if there is no opportunity for individual treatment.

In schools abroad the study of languages is begun at a much earlier age than with us, and the introduction of a language in the junior high school, for those who wish it, should be carefully considered. A good teacher of Latin or French or German may give a better training in the correct use of the English language than that given by much of the current instruction in English.

In the junior and senior high schools we have given too much emphasis to the preparation of the student for economic production and not enough to his preparation for a sane and happy intellectual life. It seems clear that if we are to distribute work equitably under modern conditions men and women in the future should devote fewer hours to toil and will have more hours for recreation. To use this happily they must have intellectual resources. There should be training in art, pictorial, musical, dramatic and literary.

It is estimated that 60 per cent. of our young people of high-school age are in the high schools. I can think of no other respect in which our civilization differs so

radically from that of Europe. A part of these high-school years should be used to give our young people a comprehensive—not a detailed—knowledge of their environment; of its historical background in astronomy, geology, archeology and ethnology; also of the cultural development of the race in art, literature, government and science. Especial emphasis should be placed on the scientific method and on the way in which the use of that method has transformed our environment within a few generations. The development of the automobile and of the airplane are significant as recent applications of such methods.

The scientific method should also be illustrated by laboratory instruction. This should be used to show the connection between experiment and the theories which furnish the golden threads by means of which, alone, a comprehensive knowledge of our environment is possible. We must understand that the acquisition of detailed facts is an incidental rather than a primary purpose. In high school, pupils should begin to think seriously about their future careers, but unless they develop some very definite aptitude they should not prepare for any particular science. There is great danger in too early specialization. They may well decide, however, whether they wish to enter some academic or professional career or whether they prefer to follow some other course in life. If they decide on a career of the former type they should almost certainly make a beginning with French and German, the two languages which will open to them rich storehouses of material.

The most indispensable element in the training of any high-school pupil, no matter what his career is to be, is that he should form the habit of testing his knowledge by observation, experiment and experience and that he should be careful about accepting dogmatic statements before subjecting them to these tests. He should learn, however, that hasty conclusions from experience are often wrong and that conclusions should be examined from many different angles before allowing them to become fixed convictions. A clear understanding and constant use of the scientific method is even more necessary for historians, economists and students of political science than for the chemist or biologist.

In college the man who wishes a thorough training in chemistry and who aspires to become something more than ordinary should continue to broaden and deepen the foundation for his studies, especially in mathematics, physics and biology.

The complaint has often been made of teachers of chemistry that they expect of their students too much detailed knowledge of the subject. Chemistry has been contrasted unfavorably with physics in this respect. It is especially important that the student should cultivate a selective rather than an encyclopedic memory. Such an ability comes from storing the mind with a very considerable amount of detail and by gaining the experience necessary to distinguish between things which are trivial and those which are important. The ordinary examination is poorly adapted to discover this sort of ability. For advanced students it is probably best developed by "seminars" in which students report on articles in current literature.

The ability to find needed information in handbooks and journals is increasingly important. The student should not be expected to find his way alone in the labyrinth of material available, without some special instruction in its use.

The practical application of knowledge is one of the best methods of fixing it in the mind and making it permanently useful. For this reason some experience in solving a new problem is a valuable element, even in a four-year undergraduate course in chemistry or in chemical engineering. A piece of experimental work carried out by a senior at the Rose Polytechnic Institute proved to be the starting point for some of the most important work that I have done. However, no professor should ever consider a student, whether an undergraduate or a candidate for the doctor's degree, as merely a tool to perform experiments of interest to himself. The advantage to the student should always be considered as the primary purpose. Not only should the topic be selected with the student's interest in view, but the student should be compelled to develop the greatest possible initiative in the preliminary study of the literature and in his work in the laboratory.

There is a fundamental difference between the work of a student and that of an employee in a factory, but the distinction is not so sharp as is generally supposed. Some of our most efficient industrial laboratories allow a certain amount of work that has no immediate economic significance. The laboratory of the General Electric Company is a notable exponent of this policy.

Whatever the policy of the management, the industrial chemist should never permit himself to think that he is merely a cog in a machine that is accumulating profits for a corporation whose directors often know very little about chemistry. Whether his work may seem small or great, he should think of it as a unit in a cooperative, democratic organization which serves the community and gives a reasonable return to workers, directors and capital. It is as this spirit permeates the whole community that we shall find the way out of the depression which has hung over us for six years past.

OBITUARY

ARTHUR DEHON LITTLE

"DEDICATED to Industrial Progress." These words, carved on the west wall of the vestibule of the A. D. Little Laboratories in Cambridge, Massachusetts, are the key to the spirit of the research institution founded in 1886 by Dr. Arthur D. Little in conjunction with Roger B. Griffin. No less is this inscription an expression of one of the chief motives of the life of its author. Dr. Little continuously bore witness to his conviction that research was the price of progress in industry. "To those with vision," he claimed, "science is bringing countless new opportunities for constructive and profitable effort, while it is likely to take whatever they may have from those who will not see." He carried this theme into his contacts with the financial world, where often final decisions are made affecting industrial policy. "While every chemist will admit he needs a banker," he wrote, "the fact that every banker needs a chemist is not yet recognized in financial circles."

Dr. Little's conception of the value of science, chemistry in particular, to industry was complemented by his resolute stand for the dignity of the profession of chemistry. With him it was almost an axiom that the chemist was worthy of recognition by men of affairs. In this connection, Dr. Little had in mind chemists with something more than technical knowledge. He meant for scientists, generally, to have an outlook on life which embraced the widest possible acquaintance with the achievements of mankind. In other words, the scientist was to be a member, in good standing, of the "fifth estate," characterized by him as "composed of those having the simplicity to wonder, the ability to question, the power to generalize, the capacity to apply, in short, the company of thinkers, workers, expounders and practitioners upon which the world is absolutely dependent for the preservation and advancement of that organized knowledge which we call science."

A native of Massachusetts, Arthur D. Little was born in Boston on December 15, 1863, the son of Thomas J. and Amelia Hixon Little. His early education was obtained, in part, in the public schools of Portland, Maine. He enjoyed telling how, for ten cents, in that city one afternoon in 1875 or 1876 he witnessed the chemical demonstrations of a traveler, and how the interest aroused by the experiments stirred in him the determination to become a chemist. He began experiments in his grammar school days in a home laboratory, and throughout the rest of his life he never lost contact with the facilities of a laboratory. The more formal part of his education was received at the Massachusetts Institute of Technology, where he was a member of the class of 1885. He never pursued graduate studies, but he held several honorary degrees. In 1918 the University of Pittsburgh conferred on him the doctorate in chemistry. The University of Manchester, England, granted him the honorary doctorate of science in 1929, as did Tufts College in 1930 and Columbia in 1931.

After working a year as a chemist to the Richmond Paper Company at Rumford, Rhode Island, his life's work began in 1886, when, in partnership with Roger B. Griffin, he founded a scientific research organization to aid clients. This was the first such institution in the United States. The new firm carried on a general commercial practise of chemistry until Mr. Griffin died in 1893 as the result of injuries received in the laboratory. The early years of the work fell in a period when industry was not convinced of the value of investigations, and Dr. Little often found it necessary to stand his ground with the zeal of the pioneer. During that time valuable patents were taken out on processes for the manufacture of chrome-tanned leather, potassium chlorate and cellulose acetate.

In 1900 a new partnership was formed with Dr. Willis R. Whitney, which continued until the incorporation of the firm in 1909. The present dignified building with its well-equipped laboratories and library was erected on the banks of the Charles River in Cambridge in 1917. Out of the laboratories has come a long list of industrial developments. Among the contributions are processes for smoke filters, for newsprint from southern woods, for the recovery of naval stores, for the utilization of waste products from lumbering, for the production of non-inflammable movie films, artificial silk, airplane dopes, automobile finishes, stereotype mats, and other things.

Through much of his mature life, Dr. Little held prominent positions in his scientific societies. In 1899 he became the second chairman of the Northeastern Section of the American Chemical Society, following Professor Arthur A. Noyes in that position. The American Chemical Society honored him as its president in 1912 and in 1913. In 1919, he was president of the American Institute of Chemical Engineers and in 1928–1929 of the London Society of Chemical Industry. In addition to strictly professional societies, Dr. Little was a member of the American Academy of Arts and Sciences, of the Franklin Institute of Philadelphia and of the Royal Society of Arts.

Dr. Little always found time to continue associations with the Massachusetts Institute of Technology. He was president of the Alumni Association in 1921–1922 and in 1923 he was made a life member of the corporation of the institute, after serving as a term-mem-

ber from 1912 to 1923. Probably his most outstanding achievement for education was his conception and initiation of the School of Chemical Engineering Practice of the Massachusetts Institute of Technology. According to the plan of this course, a carefully selected group of graduate students spends six months at three field stations, located at Bangor, Maine; Buffalo, New York; and Boston, Massachusetts. Six different manufacturing companies open their plants for the instruction of students who devote their attention chiefly to the application of theory to practice and to quantitative measurement of the efficiency of the so-called "Unit-operations" carried on at these plants. Dr. Little's long association with the Institute culminated in the provisions of his will, which directed that his controlling interest in Arthur D. Little, Inc., be held in trust for the benefit of the Massachusetts Institute of Technology. Thus the company which absorbed his chief efforts for almost half a century will be continued, in part by the cooperation of his alma mater.

A portrait of Dr. Little is not completed by an account of his business and scientific activities. He had the pleasure of being a member of the Century Club and the Chemists' Club of New York; the Country Club of Brookline, Massachusetts; the Examiner, St. Botolph and Union Clubs of Boston. His interest in literature was recognized by membership in the Odd Volumes Club of Boston and in the Thursday Evening Club. Through the pages of "The Handwriting on the Wall," his convictions on the value of scientific research to industry reached a wide public. The early volume with Roger B. Griffin on "The Chemistry of Paper Making" is known to all who are interested in the manufacture of paper. In 1931 he was awarded the Perkin Medal as "The American Chemist who has most distinguished himself for his services to applied chemistry."

During the world war Dr. Little was a consultant to the Chemical Warfare Service of the Signal Corps. He was in charge of airplane dopes, acetone production, etc., and he invented the "sucked-on" gas filter which was adopted as part of the standard equipment of the United States Army. Other public services included the chairmanship of the Advisory Committee of the National Exposition of Chemical Industries, membership in the Division of Engineering and Industrial Research of the National Research Council. He served, also, as a member of the Advisory Board of the Superpower Survey of the U. S. Geological Survey.

In the midst of heavy demands on his time and energies, Dr. Little had the ability to find room for life's amenities. Younger chemists found him ready to discuss their problems with them. He made them feel that their difficulties were his. He took pains to become personally acquainted with all members of the research staff. The pleasant atmosphere of the lunch room, on the second floor of the laboratory building, often became the background for informal conversations. The museum, directly connected with Dr. Little's office, contains exhibits of the earliest and latest work of the laboratories. Here one can see an expression of Dr. Little's own artistic temperament contrasted with present-day modernistic tendencies in advertising. Examples of such early developments as researches on textile fibers and the manufacture of paper from southern woods still bear witness to Dr. Little's personal work. Here, also, are representative samples from his collection of water-marked papers and the famous silk purse from the sow's ear. In his home Little had a collection of small-size pieces of Chinese porcelains.

On January 22, 1901, he married Henrietta Rogers Anthony, of Boston. They made their home in Brookline, Massachusetts, but spent part of the summer at Northeast Harbor, Maine, and the winter season found them in Florida.

Dr. Little died at his summer home on August 1, 1935. He is survived by Mrs. Little, by a brother, Edward H. Little, of Newtonville, Massachusetts, and by a nephew, Royal Little, of Providence, Rhode Island.

AVERY A. ASHDOWN

RECENT DEATHS

DR. FREDERICK LESLIE RANSOME, professor of economic geology at the California Institute of Technology, for many years geologist in the U. S. Geological Survey, died at Pasadena on October 6 at the age of sixty-seven years.

DR. WILLIAM E. GEYER, professor emeritus of physics at the Stevens Institute of Technology, last surviving member of the original faculty of 1870, died on October 8 at the age of eighty-seven years.

DR. EUGENE WESLEY SHAW, formerly of the U. S. Geological Survey, later chief geologist to the Iraq Petroleum Company, died on October 7 at the age of fifty-four years.

THE death is announced of Dr. Samuel Cox Hooker, research organic chemist, formerly a director and one of the chief technicians of the American Sugar Refining Company, at the age of seventy-one years.

PENNOCK MARSHALL WAY, vice-president and general manager of the Arthur H. Thomas Company, Philadelphia, died on October 4. Mr. Way was a member of the American Chemical Society and of the American Association for the Advancement of Science.

PROFESSOR SIR JOHN CUNNINGHAM MCLENNAN, emeritus professor of physics at the University of

Toronto, died of a heart attack in the Paris-Boulogne train on October 9. He was sixty-eight years old.

SIR FREDERICK CONWAY DWYER, formerly president of the College of Surgeons of Ireland and operating surgeon to the King George V Military Hospital, died on October 10. He was seventy-five years old.

SCIENTIFIC EVENTS

THE ANNUAL INSPECTION OF THE BRITISH NATIONAL PHYSICAL LABORATORY

AT the annual inspection by the General Board of the British National Physical Laboratory at Teddington, a large gathering of scientific men was received by Sir F. Gowland Hopkins, chairman of the board, Lord Rayleigh, chairman of the executive committee, and Sir Joseph Petavel, director of the laboratory.

The London *Times* gives the following account of some of the more important exhibits:

In the oppressive heat many of the guests would have liked to turn the Alfred Yarrow tank into a swimming bath, but instead they were shown how the laboratory hopes to reduce the pitching and heaving of ships. As in all scientific problems, the first step is to gain knowledge of the conditions under which pitching and heaving take place. A model of a twin-screw cross-channel steamer was driven by its own screws through the rough water created in the tank by a motor-driven wave-maker. The power required to propel the model, and the revolutions and thrust of the model screws, were automatically inscribed on apparatus installed in the hull, together with the pitching and heaving motions to which it was subjected. Research into the effects produced by changes in hull form upon the behavior of such craft has already produced ideas which should lead to the reduction of pitching and heaving, and therewith of seasickness.

Another piece of apparatus demonstrated in the William Froude Laboratory was the Lithgow Propeller Tunnel. When a ship propeller rotates in water there is a serious erosion or destructive action on that side of the blades which is under reduced pressure. Little is known of the cause of this action, and through the generosity of Sir James Lithgow a propeller tunnel has recently been built for its study. The tunnel consists essentially of a large hoop of steel tube through which water circulates at known speed, and in which the pressure can be greatly reduced. A model propeller is rotated in the stream of water, and its action is observed through a window. The thrust and torque on the propeller and the number of revolutions are automatically recorded.

The physics department showed apparatus, nicknamed the "clucking hen," for finding lost radium. Despite all care needles containing radium are occasionally lost after operations in hospitals, and may be whisked away immediately to the incinerator, after which they become exceedingly difficult to trace. The new apparatus constructed by the laboratory includes a loud-speaker which makes a "clucking" noise when in the neighborhood of radium, and as it approaches more closely to the radium the louder and more frequent do the "clucks" become. The investigator proceeds in his search, getting "warmer" until the radium is located.

The physics department also gave a demonstration of the nuisance which may be caused to the occupants of a flat by people walking over the floor above them; it was shown how the noise might be greatly reduced by the placing on top of the ordinary floor of a floating floor consisting of concrete slabs resting on rubber pads.

The Ministry of Transport requires the red rear reflectors of cyclists to meet a standard laid down. The laboratory carries out tests of specimen reflectors to ensure that they comply with the regulations, and the test was demonstrated. About four specimens in five submitted fail to meet the test.

The aerodynamics department showed why aeroplanes should have smooth surfaces, and the new wind tunnel, in which speeds of 650 miles an hour can be simulated, was shown working.

CHEMISTRY AT THE BROOKLYN COLLEGE

AFTER almost a year of intensive preliminary planning, construction on the permanent home of Brooklyn College was officially begun on October 2, when Mayor La Guardia turned the first spadeful of earth at the site at Bedford Avenue and Avenue H in Flatbush. Funds for housing this newest member of New York's system of municipal colleges have been provided by the Federal Public Works Administration and by the city, and will suffice to erect at present four of the principal units of the plant: the Academic Building, the Science Building, the Gymnasium and the Power Plant. The total cost of the project will be $5,500,000.

The work of the department of chemistry will be carried on in the Science Building, in a section extending vertically through the six stories. Provision has been made for two thousand students enrolled in the eighteen or more courses offered. Lectures and recitations for all classes will be held in three fully equipped lecture rooms, with a total capacity of six hundred, and a number of small recitation rooms; while laboratory work will be conducted in small rooms designed to accommodate sections of twenty students in organic chemistry and twenty-four in other subjects. The largest courses, those in general chemistry, will require nine laboratory rooms. Four laboratories have been assigned to qualitative analysis, and four to organic chemistry, and additional rooms for upper-class work in quantitative analysis, in biochemistry and in physical chemistry. Connected with the various laboratories will be accessory balance

rooms and dark rooms, a combustion room and a steam room and there will be a general laboratory for special advanced work.

The planning of the general layout and complete laboratory services for the department and the preparation of equipment specifications are in the hands of a departmental committee consisting of the acting chairman, Professor Martin Meyer, and Professors Hart, Stone, Mossman and Masterson, Drs. Weber, Sattler, Whittaker, Bacharach, Tobin and Livingston and Mr. Hübner. This group, which has been assisted by all the members of the department, is collaborating with the college committee in charge of plans, of which Professor Frederick E. Breithut is chairman, and with the architects and engineers.

Construction bids for the Science Building were opened on October 16 and equipment bids will be opened by November 1. A time limit of one year has been set for the completion of the whole project.

CONSERVATION OF MIGRATORY BIRDS

Any doubts entertained by sportsmen as to the constitutionality of Federal restrictions on the hunting of migratory birds have been answered, says the U. S. Biological Survey in commenting on a recent decision in Federal court at Savannah, Ga. The survey administers the regulations adopted under the act of Congress giving effect to the treaty for the protection of birds migrating between this country and Canada.

Overruling a demurrer to an indictment for hunting mourning doves over a baited area, Federal Judge William H. Barrett has upheld the power of the Secretary of Agriculture to regulate hunting methods. Judge Barrett's decision, following by only a few days a similar decision by Judge H. Church Ford at Lexington, Ky., sustaining the secretary's power to limit open seasons, led survey officials to express the opinion that these two decisions effectively answer all constitutional objections to this year's hunting regulations.

"The principal question presented in this case," said Judge Barrett in the Savannah decision, "is: Has Congress the right to delegate to the Secretary of Agriculture the authority to make penal the shooting of doves over a baited field when neither the treaty between the United States and Great Britain nor the Act of Congress creates such a penalty?" The defendants argued that the regulations represented an unconstitutional grant of legislative power.

The rule to be followed is well established and quoted from the recent Schechter NRA case as follows: "So long as a policy is laid down and a standard established by a statute, no unconstitutional delegation of legislative power is involved in leaving to selected instrumentalities the making of subordinate rules within prescribed limits and the determination of facts to which the policy as declared by the legislature is to apply."

In providing for the conservation of migratory birds, Congress, in delegating power to the Secretary of Agriculture, "surely," said Judge Barrett, "lays down 'its policies and establishes its standards,' namely, the policy that there shall be no hunting of migratory birds except as may be permitted by the Secretary of Agriculture. The standard is that the means of hunting shall be 'compatible with the terms of the convention.' It seems clear to me that this delegation is well within the prescribed rule."

The decision was handed down on September 5.

THE ANDREW CARNEGIE CENTENNIAL CELEBRATION

An announcement of the program of the Andrew Carnegie Centennial Celebration, which will be held on November 25, 26 and 27 in New York, Pittsburgh, Washington and other cities and communities throughout the country, has been made by Dr. F. P. Keppel, president of the Carnegie Corporation of New York, the largest of the six Carnegie foundations in the United States.

Andrew Carnegie was born on November 25, 1835, in a weaver's cottage in Dunfermline, Scotland, the ancient Caledonian capital from which his family emigrated to America in 1848. It was in Dunfermline that Carnegie built his first library and began in 1881 his series of library benefactions that continued until 1917, by which time he had built 1,946 free public libraries in the United States and 865 in other parts of the English-speaking world.

The different Carnegie trusts in this country which will participate in the centennial celebration, in the order of their establishment, are:

Carnegie Institute of Pittsburgh, 1896, which conducts an institute of technology, a museum of fine arts, a music hall, a museum of natural history, a public library and a library school.

Carnegie Institution of Washington, 1902, devoted to scientific research.

Carnegie Hero Fund Commission, 1904, to recognize heroic acts performed in the peaceful walks of life.

The Carnegie Foundation for the Advancement of Teaching, 1905, to provide retiring pensions for teachers and to advance higher education.

The Carnegie Endowment for International Peace, 1910, to serve the purpose indicated by its name.

Carnegie Corporation of New York, 1911, for the advancement and diffusion of knowledge and understanding among the people of the United States and the British Dominions and Colonies.

While each of these organizations will observe the centennial with its individual program, all will join in the three principal events in New York City. These

will consist of a special choral-orchestral performance in Carnegie Hall on Monday evening, November 25; a formal assembly at the New York Academy of Medicine on the evening of November 26, and a dinner at the Waldorf-Astoria Hotel on the evening of November 27.

In addition, the American Library Association, which will participate with the Carnegie trusts in the celebration, has suggested the theme of "One Hundred Years of Library Progress" for the Carnegie observance in public libraries throughout the country. As a part of the centennial observance, the trustees of the Carnegie Corporation are presenting to all Carnegie libraries a reproduction of a portrait of Andrew Carnegie by F. Luis Mora, framed for permanent display. The corporation is also making available through the American Library Association a series of posters containing quotations from the writings of Andrew Carnegie.

In the program of Carnegie centennial events, as tentatively arranged, the special choral-orchestral performance at Carnegie Hall, New York, on Monday evening, November 25, will be reminiscent and commemorative of the festival with which The Music Hall, which Mr. Carnegie built for the civic and cultural advancement of New York City, was opened on Tuesday evening, May 5, 1891.

On the day following, November 26, the formal assembly at the New York Academy of Medicine will be held as a memorial to Andrew Carnegie for his many benefactions in different fields for the advancement of mankind. Dr. Nicholas Murray Butler, president of the Carnegie Endowment for International Peace and of Columbia University, will preside at this assembly, which will be addressed by Sir James Irvine, principal and vice-chancellor of St. Andrews University, Scotland, which with the other Scottish universities is the beneficiary of a Carnegie trust. Sir James Irvine will be the official representative at the American Carnegie celebration for the four British Carnegie Trusts. These are the Carnegie United Kingdom Trust, Carnegie Dunfermline Trust, Carnegie Trust for the Universities of Scotland and Carnegie Hero Fund Trust. Similarly, Dr. John Finley, of *The New York Times*, will represent the Carnegie trusts of the United States at the Carnegie Centennial Celebration in Dunfermline.

The final event on the program in New York will be the dinner on the evening of November 27 at the Waldorf-Astoria Hotel, at which Dr. Henry S. Pritchett, president emeritus of the Carnegie Foundation for the Advancement of Teaching, will preside. Dr. Keppel and President James Bryant Conant, of Harvard University, will speak.

SCIENTIFIC NOTES AND NEWS

ON the occasion of the fiftieth birthday of Professor Niels Bohr, director of the Copenhagen Institute of Theoretical Physics, he was presented with half a gram of radium for research on the constitution of matter. The Copenhagen correspondent of Science Service, which sends this information, states that ten scientific foundations and eight industrial firms of Denmark joined in making this gift. Physicists from all nations sent messages of congratulations.

FOLLOWING the retirement of Dr. Simon Flexner, the honorary titles of director emeritus and member emeritus of the Rockefeller Institute for Medical Research have been conferred upon him.

DR. FLORENCE RENA SABIN, a staff member of the Rockefeller Institute for Medical Research since 1925, previously professor of histology at the Johns Hopkins University, has been awarded the M. Carey Thomas Prize of $5,000 of Bryn Mawr College, which is given at intervals to an American woman in recognition of eminent achievement. The presentation will be made on November 2 on the occasion of the celebration of the fiftieth anniversary of the founding of the college.

THE American Public Health Association at its sixty-fourth annual meeting in Milwaukee awarded the Sedgwick Memorial Medal to Dr. Haven Emerson, of the College of Physicians and Surgeons of Columbia University. The presentation was made by Dr. William H. Park, of the Department of Health of New York City. The medal has been established in honor of the late William Thompson Sedgwick, of the Massachusetts Institute of Technology, and is awarded for distinguished service in public health.

PRESENTATION of the Acheson Medal to Dr. F. J. Tone was made at the annual dinner of the American Electrochemical Society, which met in Washington on October 10, 11 and 12. The medal and a prize of $1,000 was awarded in recognition of Dr. Tone's accomplishments in electrothermics.

THE Josef-Schneider Medal of the faculty of medicine at the University of Würzburg has been awarded to Dr. Fritz Lenz, professor of racial hygiene at Berlin.

THE Robert Koch Medal has recently been awarded by the City of Berlin to Dr. Ferdinand Sauerbruch, professor of surgery in Berlin; the Emil Fischer Medal to Dr. Adolf Butenandt, professor of organic chemistry and technology in Danzig, and the Liebig Medal to Dr. Walther Roth, professor of physical chemistry at Brunswick.

THE Association for the Study of Neoplastic Diseases held a dinner on September 6 in honor of Dr. Joseph C. Bloodgood, adjunct professor of surgery at the Johns Hopkins University School of Medicine and one of the founders and directors of the association, during its annual meeting in Washington, D. C. Dr. John Shelton Horsley, Richmond, Va., presided; Dr. Clarence C. Little, managing director of the American Society for the Control of Cancer, was among the speakers.

THE Ernest Kempton Adams Research fellowship in chemistry of Columbia University has again been awarded for the academic year 1935–36 to Professor Harold C. Urey, discoverer of heavy water and Nobel Prize winner. Professor Urey has held the Adams fellowship, valued at $1,250, since 1933. The appointment is made annually "from among the faculties, teaching staff, alumni or students of Columbia University, or from among the distinguished physicists of the United States or of any foreign country." With the aid of an assistant, Professor Urey will attempt to separate carbon and nitrogen isotopes.

DR. THOMAS H. PARRAN, JR., New York State Commissioner of Health, was elected president of the American Public Health Association at the recent annual meeting at Milwaukee.

DR. EDWARD CATHCART has resigned as associate dean of the College of Physicians and Surgeons of Columbia University. Dr. Cathcart, who went to Columbia in September, 1934, will return to private practise in Detroit.

DR. CHAUNCEY D. LEAKE, professor of pharmacology and head of the department in the Medical School of the University of California, will continue the work of Dr. S. V. Larkey, who has been assistant professor of medical history and librarian of the Medical School Library. Dr. Larkey left San Francisco on September 30, to assume the post of librarian of the Welch Memorial Library at the Johns Hopkins University.

AT Columbia University, Dr. Marshall Avery Howe, recently elected director of the New York Botanical Garden, has been made professor of botany. Dr. Howe was curator of the herbarium at Columbia University from 1899 to 1901. Other appointments include Dr. Harold Alexander Abramson, assistant professor of physiology; Dr. Cornelius G. Dyke, assistant professor of radiology; Dr. Albert Victor Hardy, assistant professor of epidemiology, and Dr. C. Wadsworth Schwartz, organizer of the x-ray department of the Neurological Institute, associate professor of clinical radiology, and Hadley Cantril, instructor in psychology at Harvard University, assistant professor of education.

DR. H. S. REED, professor of plant physiology at the Citrus Experiment Station of the University of California at Riverside, has been transferred to the division of plant nutrition, of the College of Agriculture, at Berkeley. Dr. I. J. Condit, associate professor of subtropical horticulture at Los Angeles, has been transferred to the Citrus Experiment Station of the Riverside branch of the College of Agriculture in order that he may devote his full time to the direction of a program of research on the fig and the olive. To fill the vacancy created by Dr. Condit's transfer, Dr. F. F. Halma, assistant plant physiologist at Riverside, has been transferred to Los Angeles with the additional title of assistant professor of subtropical horticulture.

AS has been recorded in SCIENCE, Dr. Bernard Smith has been appointed to succeed Sir John Flett as director of the Geological Survey of Great Britain. It is now announced in *Nature* that Henry Dewey has been appointed to succeed Dr. Bernard Smith as assistant director (England and Wales). C. E. N. Bromehead, district geologist in York, will shortly take charge of the London District, now vacated by Mr. Dewey. T. H. Whitehead has been promoted to district geologist and will take over the Survey Office in York upon Mr. Bromehead's withdrawal to London. Dr. J. Phemister has been appointed petrographer in succession to the late Dr. H. H. Thomas.

DR. ROBERT BALK, for the last ten years a member of the teaching staff at Hunter College, has become chairman of the department of geology and geography at Mount Holyoke College.

R. L. GOODSTEIN, Magdalene College, Cambridge, has been appointed to the post of lecturer in mathematics at the University of Reading.

DR. COSSLETT, of Bristol University, and Mr. Stienon, of London, have been appointed to the teaching staff of Faraday House Electrical Engineering College.

DR. WILLIAM H. SLAUGHTER, senior surgeon of the U. S. Public Health Service, has taken charge of the U. S. Marine Hospital in New Orleans. He succeeds Dr. Thomas B. H. Anderson, who has been transferred to the marine hospital in Baltimore.

DR. GEORGE A. HAYS, of the U. S. Public Health Service, formerly with the Missouri State Board of Health, Jefferson City, has been appointed state epidemiologist of Arizona, succeeding Dr. Hugh F. Stanton, resigned.

DR. N. W. POPOFF, of the Highland Hospital of Rochester, N. Y., has been awarded a grant by the Committee on Scientific Research of the American

Medical Association for the continuation of his work on arteriovenous anastomoses.

PROFESSOR JOHN W. GREGG, professor of landscape design at the University of California and consultant in landscape design, has been appointed landscape architect for the All-American Canal to be built at Calexico, California, as part of the Colorado River project.

CAPTAIN ROBERT A. BARTLETT has returned on the *Morrissey* to New York from his annual summer voyage to the more remote coasts of Greenland. This summer he penetrated to within 700 miles of the North Pole, almost to the northern tip of Greenland. The expedition secured a large collection of specimens, together with meteorological and ethnological data. Captain Bartlett's voyages each summer have been sponsored by the Field Museum, Chicago, the Philadelphia Academy of Sciences and the Museum of the American Indian, Heye Foundation, New York.

A COLLECTION of 1,500 fossil bones of small mammals of the Paleocene age has been brought from the Crazy Mountains in Montana to the American Museum of Natural History by Dr. George Gaylord Simpson, assistant curator of vertebrate paleontology. Dr. Simpson returned recently from a four months' expedition made possible by gifts from H. S. Scarritt, New York broker, and Mr. and Mrs. Fenley Hunter, of Flushing, N. Y.

DR. B. E. DAHLGREN, head botanist of the Field Museum of Natural History, and Dr. J. V. Steinle, research chemist, left Chicago on October 8 for a 22,000 mile, three months' airplane expedition in the jungles of Brazil. They will aid H. F. Johnson, president of S. C. Johnson and Son, Inc., wax makers, in a search for Carnauba palm trees, which provide nut oil used in making waxes and polishes.

DR. JOHN HERR MUSSER, of the School of Medicine of Tulane University, gave an address at the University of Alabama on the anniversary of the birth of the late William Crawford Gorgas. Dr. Musser's address, which was a part of the annual Gorgas Day celebration held by the Gorgas Medical Society at the School of Medicine, was entitled "The Life and Work of Sir William Osler, with some Personal Reminiscences."

AT the one hundred and eighty-seventh meeting of the Philosophical Society of Washington, Dr. J. Bartels, professor of meteorology at the Forstliche Hochschule in Eberswalde and lecturer in geophysics at the University of Berlin, spoke on "Some Aspects of Geophysical Cycles."

WE learn from *Nature* that the opening lecture of a series on "Scientific Progress," organized by the Sir Halley Stewart Trust, will be given by Sir James Jeans in the Memorial Hall, Farringdon Street, London, on October 22. The subject will be the new world picture as seen by the modern physicist. Other contributors to the series are Sir William Bragg, Professor E. V. Appleton, Professor E. Mellanby, Professor J. B. S. Haldane and Professor Julian Huxley.

THE twelfth year of lectures in contemporary thought at Northwestern University, which is open to the public without charge, began on Wednesday, October 9, at three P. M. in Harris Hall, on the Evanston campus, and at seven P. M. in Thorne Hall. The first lecture was given by Dr. Harvey B. Lemon, professor of physics at the University of Chicago, on "The Material Cosmos." This year the series of lectures will be built around the general theme of "The Distributive Society," in which production is for direct consumption. The first group in the series provides study of the nature of energy and the resources of energy and power in the modern world. This will be followed by discussion on anthropology and sociology in a study of the distributive patterns among primitive peoples. Finally, a number of engineers and social scientists will discuss the possibilities of a distributive society in a modern scientific world. The second semester of the lectures will be devoted to the presentation of modern points of view in religion, art, music and philosophy and their bearing on the possibility of self-sustaining, decentralized societies in the modern world. Baker Brownell, professor of contemporary thought at Northwestern University, is directing the program of lectures.

AT the tenth International Congress of the History of Medicine, held in Madrid from September 23 to 29, the official delegates from the United States were Dr. Henry E. Sigerist, professor of the history of medicine at the Johns Hopkins University; Dr. Howard Dittrick, of Cleveland; Dr. Edward Bell Krumbhaar, of Philadelphia, and Dr. Emily Walcott Emmart, of the Johns Hopkins University. Dr. Sigerist, Dr. Dittrick and Dr. Krumbhaar represented the American Association of the History of Medicine and Dr. Emmart represented the Smithsonian Institution. The honorary doctorate of the Medical Faculty of the Alcala de Henarez, which was founded by the Cardinal Cisneros in the sixteenth century, was conferred by the College of Physicians of Madrid, which took the place of the Medical School of Alcala when the University of Madrid was founded. Those who received the degree were Professor Dr. Davide Giordano, of Italy; Professor M. Laignel-Lavastine, of France; Professor Max Neuburger, of Austria; Professor Paul Diepgen, of Germany; Professor Victor Gomoiu, of Rumania; Professor Tricot-Royer, of Belgium; Sir Humphry

Davy Rolleston, of England, and Dr. Henry E. Sigerist, of the United States.

AT the conference of directors of European Zoological Gardens recently held at Basle, Switzerland, it was decided to enlarge the scope of the conference by making it international. So far Germany, Austria, Switzerland, Holland, Poland and the Scandinavian countries have been represented. It is hoped now to include directors of Zoological Gardens from Great Britain, the United States, France, Belgium and other nations. The meeting in 1936 will be held in June at Cologne.

THE 1935 annual meeting of the Texas Academy of Science will be held at College Station from November 8 to 9. The general program is as follows: Friday, November 8, forenoon: Opening business session followed by technical sessions of the various sections. Afternoon: Continuation of the technical sessions by sections. 6:15: Annual dinner of the academy and its affiliated societies. 8:00: Lecture by an outstanding scientist. Saturday, November 9, forenoon: Business session of the representatives of the affiliated societies. General technical session. Noon: Academy luncheon followed by the final business session. Afternoon: Meetings of the various affiliated societies; field trips; meeting of the junior academy of science. 6:15: Dinners of the affiliated societies; junior academy dinner followed by their business session. 8:00: Lecture under the auspices of the Central Texas Section of the American Chemical Society. Requests for space for exhibits should be made to the secretary, Frederick A. Burtt, College Station, at once.

A FUND of $40,000 has been donated by the Supreme Council, Scottish Rite Masons, for the study of dementia praecox. The research program will be under the direction of the National Committee for Mental Hygiene.

DISCUSSION

ZOOLOGY AND THE MOVING PICTURES

To those who are interested in the preservation of the native fauna, no recent book is so interesting or so significant as "Pilgrims of the Wild," by Grey Owl, lately published in London.[1] Grey Owl, already well known for his writings, is of Scotch and Indian (Apache) parentage and was adopted into the Ojibway tribe of northern Ontario. He tells us how he was a hunter and trapper, who gradually came to feel that it was his mission to defend the life of the northern forests, and the beaver in particular; and how, after many tribulations and much hardship, he won success. An editor who had been printing his articles brought them to the attention of the Canadian Parks Service, suggesting that the activities of the beavers should be recorded in moving pictures. This was done, and to-day there are several reels available (16 mm film), presenting a wonderful picture of beaver life. They have been shown all over Canada and in other countries. My wife, thanks to the courtesy of the Canadian Parks Service, has been able to show them to many thousands in Colorado, California and Wyoming, always meeting with enthusiastic appreciation and requests to have them repeated. There can be no doubt that the moving picture was a major factor in determining the Canadian policy with reference to the beaver. The officials of the Parks Service were already interested in conservation, but it was the picture which reached the people, and aroused their lively interest and sympathy. Thus every one felt that he personally knew what it was all about and that it was his concern to see that the wild life of the country should not be utterly destroyed. The democratization of conservation, if we may so term it, has been one of the most interesting and hopeful movements of modern times, and the results are apparent all over the world.

The pictures appeal both to the intellect and the emotions. Zoologists preserve in museums the bodies of animals and describe the genera and species as illustrated by such materials. Yet every creature has its pattern of behavior, the elements of which can be determined as individual, specific, generic or what not, just like the structural features. Now, with the aid of the moving picture, these phenomena can be recorded, and the film so far improves on actual observation, in that it can be repeated at will, and when it is desirable, the motion can be slowed down so that every movement is easily studied. We recently offered a program to the large class in psychology at the University of Colorado, consisting of three films. The first showed the excellent team-work of a group of ants, which pulled together, as we should do, to remove an obstacle. The second was one of the Grey Owl beaver films, showing how the beavers worked on a cooperative project, but each animal worked alone. The third showed trained elephants working in the teak forests of Siam (recent picture taken by Dr. Douglas Collier), illustrating the extraordinary intelligence and educability of these

[1] Lovat Dickson and Thompson, Ltd., 38 Bedford Street. January, 1935.

animals. We have several pictures of bees and wasps nesting, taken in Colorado by Robert Niedrach, of the Colorado Museum of Natural History. One shows the Sphex wasp with its pebble, the beginnings of the use of a tool. Another shows the wasp which stores grasshoppers for its young. Twice a wasp is seen to drag the grasshopper in, swiftly and successfully, by the head. It looks like infallible instinct. But the third wasp takes hold of its grasshopper about the middle and has a most strenuous time because it will not go in the hole.

More and more, the pictures are coming to be used for such purposes as I have indicated, and a very long story could be written concerning activities of this type in different parts of the world. Nevertheless, we are on the threshold of the work. The coming years will certainly see great developments, especially in the educational field. The really extraordinary thing is that progress is so slow; that college departments, museums and government bureaus do not do more to develop trained workers and suitable equipment. The picture must be no longer merely for amusement; it must be designed to stimulate thought and, through thought, action. It must be the means of restoring to zoology the half of that subject which has been so greatly neglected, owing to unavoidable circumstances. Educational authorities may justly fear the deterioration of courses through the introduction of elements which appeal to the emotions, but seem to have little intellectual content. Undoubtedly this danger lurks in the careless use of the moving picture, but that is no reason for neglecting such a helpful aid. There is indeed no educational process which can not be stultified through misuse.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

GOITER PROPHYLAXIS WITH IODIZED SALT

IN the issue of SCIENCE for April 19, 1935, Dr. J. F. McClendon reported the results of goiter prophylaxis with iodized salt as used in Switzerland and the remarkable results after eleven years' trial as reported by Dr. Hans Eggenberger at the Second International Goiter Congress at Bern two years ago.

It is interesting to note that years ago this method of prevention by the use of iodized salt was tried in both Switzerland and France and then given up, owing to the fact that Breuer, Kocher and others came to the belief that iodine might do more harm than good, and cases of iodine hyperthyroidism were described in 1900.

In this country in 1907 Marine and his associates reported that iodine is necessary for the normal function of the thyroid. This work stimulated a trial of iodized salt in this country. McClendon is responsible for considerable knowledge of the distribution of food iodine with special reference to goiter. He, too, has charted the iodine supply in different parts of the states.

In Michigan iodized salt was introduced through the grocery stores by the efforts of the Pediatric Section of the Michigan State Medical Society in 1924. The results in Detroit and Southern Michigan which we have studied are astounding, as viewed from the number of enlarged thyroids amongst the school children and also the number of patients coming to operation for the three types of goiter—colloid, adenomatous and hyperplastic. In 1924 the survey by Kimball in different parts of Michigan showed a very high incidence which has always been endemic here. In Detroit it was not as high as in other parts of the states, but even here there was an incidence of 35 per cent. of enlarged thyroids in the school children. In the eleven years that have passed this incidence has gradually decreased, until now less than 1 per cent. of our school children have enlarged thyroids. After two years with the use of this salt the number of goiter operations in the seven largest hospitals in Southern Michigan began to decline, but the total of all operations performed showed but little change.[1]

The following conclusions are reached from our studies here.

(1) Iodized salt as used in Michigan did at first apparently increase the number of thyroid operations.

(2) The increase was in the nodular goiter or adenoma group, and we believe the iodized salt may have activated a group of quiescent adenomata, producing toxic goiter symptoms.

(3) The increase reached its peak in the second year after the introduction of iodized salt.

(4) An increase in the death rate from goiter as shown by the Board of Health statistics reached its peak in the second year after the introduction of iodized salt.

(5) There was no increase in hyperthyroidism, excepting in the nodular goiter or adenomata group.

(6) The number of operations for toxic diffuse and toxic nodular goiter has rapidly and steadily decreased after the apex of the second year increase had been reached.

(7) The incidence of endemic goiter or enlarged thyroid has been reduced almost to nil since iodized salt has been so widely used.

(8) We now see no cases which show the slightest ill effects from the use of iodized salt.

[1] See "Thyroid Surgery as Affected by the Generalized Use of Iodized Salt in an Endemic Goiter Region—Preventive Surgery," by R. D. McClure, *Annals of Surgery*, 100: 924–932, November, 1934.

(9) Toxic nodular goiter and toxic diffuse goiter are less apt to occur when there has been no previous enlargement of the thyroid (endemic goiter); at least this would seem a safe conclusion based on our experience.

ROY D. MCCLURE

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A NEW OCCURRENCE OF THE FLYING REPTILE, PTERANODON

THE U. S. National Museum has recently received as a gift from Tom H. Wells, of Austin, Texas, the upper half of the left humerus of a flying reptile, probably referable to the genus *Pteranodon*. The specimen is of much scientific interest, since it records for the first time the presence of this reptile in the Eagle Ford formation (Upper Cretaceous), and also from the fact that it greatly extends the geographical range of these animals in North America. Previously they have not been known to occur south of western Kansas.

On account of the scanty nature of the specimen, its assignment to the genus *Pteranodon* must be regarded as provisional, although its relatively large size is in keeping with such an identification. However, the great pneumasticity of the bone, the peculiar sculpturing of its surface and the presence of a large characteristic deltoid process clearly indicate its Pterosaurian affinities.

C. W. GILMORE

U. S. NATIONAL MUSEUM

THE FIRST SCHOOL OF CHEMISTRY

IN March, 1862, a committee of the Trustees of Columbia College recommended the granting of the petition of Charles A. Joy, professor of chemistry in Columbia, that he be allowed to start a School of Chemistry. A college catalogue issued early in 1863 carries an announcement of the School of Chemistry; advertisements stating that the School of Chemistry would open on November 1, 1863, were published in the *New York Evening Post*, the *Times*, the *Tribune*, the *Herald* and the *American Journal of Science*. On June 1, 1864, Professor Joy gave President King a check for $500, representing the excess of the receipts of the school over its expenditures. Curiously enough, the announcement of 1863 in the college catalogue also lists 32 "graduates" of the "School of Chemistry," which at that time consisted of Professor Joy and his assistant, Maurice Perkins. Some of those listed do not appear in the official Columbia alumni register as having taken any degree in 1863, others seem to have taken the A.M. degree from the college in that year or their A.B. in previous years, so the "school" was evidently not privileged to grant degrees. The simultaneous and much stronger impulse to establish a School of Mines at Columbia led to the School of Chemistry being dropped after 1864.

Being curious to know whether this was the first advertised "School of Chemistry" in the United States I turned to the usual sources of reference and was surprised to be unable to find anything in print on the subject: C. A. Browne, who is naturally the first person to turn to with such an inquiry, is now in Europe and I solicit the help of readers of SCIENCE, some of whom must know, in answering the question. Chemistry had, of course, been taught in medical schools and colleges in the United States since 1767, but when was the first "School of Chemistry" established? I would be glad to correspond directly with any one who may wish to debate whether the "school" at Columbia really had any authorized existence since it did not grant degrees.

THOMAS T. READ

NEW YORK, N. Y.

SCIENTIFIC BOOKS

ELECTRON EMISSION AND ADSORPTION PHENOMENA

Electron Emission and Adsorption Phenomena. By J. H. DE BOER. Translated from the manuscript by Mrs. H. E. Teves-Acly, 398 p., Cambridge, England: at the University Press; New York, The Macmillan Company, 1935; $5.50.

THE book covers the intimate relation between adsorption on surfaces and the phenomena of electron emission. It is a well-written monograph, which should be welcome to those interested either in adsorption or electron emission phenomenon or in both. The author, who with his associates has contributed much to the subject, has succeeded in developing a satisfactory concept of photoelectric and thermic emission of electrons from dielectrics or metals upon which alkali or alkaline earth metals are adsorbed. Without entering into highly mathematical derivations it is shown that the majority of such phenomena are easily interpreted with the aid of potential curves, the latter visually representing the relations between adsorbed atoms or ions and their adsorption energy. Thus it is even possible to predict the phenomena which will occur upon heating or radiation in cases in which the necessary energy data are available. Although the author, in his function as director of chemical research at the Philips Gloeilampen-fabriek, Eindhoven (Holland), is intimately connected with the incandescent

and radio lamp industry, he has avoided a technical discussion of the subject and has kept the contents purely theoretical. Still, the great number of facts discussed throughout the text should prove to be of great value to those especially interested in the industrial aspects of the subject.

The fundamentals concerning electron emission from metals (work function) and the nature of adsorption forces are treated in a concise but very systematic way in the first two chapters. Incidentally, the two extreme classes of chemical compounds, the polar and apolar molecules, are shortly discussed, and it is clearly demonstrated that compounds which in the solid state are constituted of ionic lattices, may form ionic or atomic molecules in the gaseous state, depending upon the location of the minimum in the potential curves for the atomic and ionic compound. The clear distinction which is made between adsorption of ions and adsorption caused by dipole attraction, electrostatic polarization and Van der Waals's forces is also valuable. Here the author has an opportunity to emphasize the significance of active places on the surface, where electrostatic adsorption is maximal and Van der Waals's adsorption minimal. Later on, the active surface of sublimated salt layers is shown to be of great significance.

The third chapter deals with the adsorption of caesium on a tungsten surface in which Langmuir's classical work is discussed from de Boer's point of view. The next three chapters consider the influence of the adsorption of metals and gases on metal surfaces on the emission of conduction electrons. Before the selective photoelectric effect is discussed, a more detailed treatment of absorption of light by matter in the gaseous and adsorbed state is given. Chapters X to XIV deal with photoelectric phenomena of adsorbed atoms on the internal surface of alkali halides and the photoionization of such atoms. Atoms which are adsorbed on an external surface of a dielectric may be ionized by the absorption of light as well as by increase of temperature. If the electrons liberated are emitted to the outside we are concerned with photoelectric or thermionic emission. Atoms adsorbed on the internal surface within a salt lattice may also be ionized by light as well as by increase of temperature. The electrons in this case are emitted into the salt lattice and it is made clear that we are concerned with the phenomena of photoelectric conduction and electronic semi-conduction. In the last chapter (XV) is discussed the possibility of atoms adsorbed on an external surface, which upon ionization may emit their electrons to the inside, *i.e.*, into the salt lattice. In this connection the theory of rectifiers is also presented.

The foregoing is only a very brief survey of the rich contents of the book. The author is to be complimented for his broad, original, highly modern, critical and concise treatise and his attempt to explain a multitude of phenomena on the basis of the same fundamental concepts. Many of the potential curves given seem to be hypothetical, but this fact should stimulate further research. The translator deserves praise, since it is hardly noticeable that the original manuscript was not written in English. Cover and print of the book are attractive.

I. M. KOLTHOFF

THE STRUCTURE OF CRYSTALS

The Structure of Crystals. Supplement for 1930–1934 to the 2nd Edition. By R. W. G. WYCKOFF. Reinhold Publishing Corporation, New York, 1935. 240 pages, $6.00. American Chemical Society Monograph Series.

THIS book, following the form of the second part of the well-known book which it supplements, contains descriptions of the new atomic arrangements in crystals reported in the literature of 1930–1934, together with a bibliography of about two thousand references. Its greatest usefulness will probably be as a convenient source of reference preliminary to the study of the original papers. As in his earlier books, the author here shows excellent judgment regarding the reliability of structure determinations, and his critical remarks should be of great value to the general reader.

The description of an atomic arrangement usually includes the size of the unit, the space group, a table of atomic coordinates, and one or two drawings, with in some cases a discussion of coordination, interatomic distances, and other structural features. In most cases this gives the reader a satisfactory understanding of the structure. In the opinion of the reviewer, however, the value of such a book would be still further increased by including more complete qualitative descriptions of the structures, with omission of long tables of atomic coordinates, which could be found in the original papers by any one sufficiently interested to make use of them. For example, very little information as to the nature of the structure reported for vesuvianite is given in the one page devoted to this crystal (p. 114–5), most of which is used for tabulating the atomic coordinates; and a half page is used for tabulating coordinates for epididymite (p. 117–8), even though the author points out that the reported structure can not be correct.

By providing this reliable survey of the extensive crystal structure literature of the last five years, the author has earned the gratitude of everyone interested in the field.

LINUS PAULING
CALIFORNIA INSTITUTE OF TECHNOLOGY

THE SIXTEENTH ANNUAL MEETING OF THE AMERICAN GEOPHYSICAL UNION

THE sixteenth annual general assembly of the American Geophysical Union and the meetings of its seven sections were held on April 25 and 26, 1935, at Washington, D. C., in the building of the National Academy of Sciences and National Research Council.

The papers presented at the general assembly were devoted to a symposium on the earth's outer atmosphere. These concerned recent developments in atmospheric absorption of light and its relation to ozone, in atmospheric ionization, in the correlation of radio transmission with solar phenomena, in the theory of the ionosphere, in the conditions resulting from the study of meteor-trains, in the contribution to atmospheric ionization by cosmic radiation, in the relation of ultra-violet solar radiation and ozone and in the relations of the aurorae and night-sky spectra to the upper atmosphere. Five reports were presented from special committees relating to geophysical and geological studies of oceanic basins (with five appendices developed from the committee's work) and of continents. As a matter of record, a complete statement regarding the cosmic-data Ursigrams and codes used was added in the transactions. Among the 16 resolutions adopted were: Three relating to suitable vessels for magnetic and oceanic surveys and for bathymetric charts; three relating to data in geophysics, geology and hydrology obtained by the federal government and to the coordination of the results; one recommending the publication of a manual of hydrology; three on the establishment of mountain stations, on the use and design of radio meteorographs and on the coordination of snow-surveys in mountain regions; and three on the establishment of additional seismograph-stations in the United States.

In the Section of Geodesy eight papers and reports dealt with time-service present and future developments, surveys in Canada and Mexico, mapping of the United States, international standardization of baseline tapes and wires, absolute gravity at Washington and progress of geodesy in the United States.

The Section of Seismology devoted particular attention to deep- and shallow-focus earthquakes in three papers, to subsurface exploration by earth-resistivity and seismic methods in one paper, to instrumental designs and studies in three papers, to propagation of waves in two papers, to motion of a viscous fluid under surface load in one paper and to a progress-report of cooperative seismological research during the year.

The rapid development and improvement in meteorological research in the United States was evidenced by the 13 papers before the Section of Meteorology. Among the subjects discussed were: Use of cloud-observations in forecasting snow-storms; methods of physical weather-analysis; hurricane-warning service and its reorganization; cyclone-frequency in the tropics and distribution and frequency of tornadoes in the United States; meteorological periods; theoretical study of wind-velocity and wind-direction; upper-air research involving use of ultra-high frequencies in tracking meteorological balloons, of the radio meteorograph and of the airplane; observations on mountain peaks, and auroral observations at the International Polar Year Station Point Barrow.

In the Section of Terrestrial Magnetism and Electricity, one paper dealt with the correlation of auroral and magnetic activities at Little America as observed by the second Byrd Antarctic Expedition; two with earth-current results, particularly during the International Polar Year; two with the application of, and instrumentation for, magnetic methods in determining subsurface geological features; and one each with earth-magnetic analysis of primary cosmic radiation, theory of rain and thunderstorms, relation of ozone-measurements and solar cycle, purpose of further atmospheric-electric measurements in the troposphere and stratosphere and the need for more detailed magnetic observations shown by the increasing application of results. Progress-reports on magnetic and electric work were received from nine governmental and private organizations in North America, including Canada, Mexico and the United States.

The Section of Oceanography heard six progress-reports on oceanographic research accomplished in Canada and the United States. Six papers dealt with the continental margin on George's Bank, seasonal temperature-variation in the North Atlantic, the natural regions of the world ocean according to Schott, California submarine canyons, hydrographic relations between the Gulf Stream and the Gulf of Mexico, and submarine daylight; and one paper dealt with the design, construction and use of a marine coring-instrument.

Three meetings of the Section of Volcanology were devoted to the presentation and discussion of 11 papers bearing on rock-types and vulcanism of southeastern and interior Alaska, of the southern Appalachians, of California, of Colorado, of southeastern Idaho, of central Montana, of New Mexico, of Nevada, of eastern Pennsylvania and Maryland, of Wyoming and of Ontario. One paper treated of the equilibrium-relations between feldspathoids, alkali-feldspars and

silica. One paper reported on the vestige of a Pleistocene thermal activity in Iceland.

As in the transactions of 1934, the annual reports submitted to the Section of Hydrology from its nine permanent research committees comprise significant digests of progress and development in investigations on snow, glaciers, evaporation, absorption and transpiration (including extended list of terms and definitions), rainfall and runoff (with five appendices of experimental studies and results), soil-moisture, underground water (with two appendices on the relations with oil fields and on active projects in California, Oregon and Washington), dynamics of streams and chemistry of natural waters. Nineteen papers and reports cover many diverse fields of hydrological research, both experimental and theoretical; they serve to emphasize the wide-spread activity in hydrology in the United States and the need for further support by state and government in this field. Three meetings of the section were held.

As in previous years the proceedings of the meetings of the Union have been edited by the general secretary for publication by the offset method. These "Transactions" will be in two parts. Part I (364 pages) will include papers and reports given at the General Assembly and at the meetings of the sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography and Volcanology. Part II (165 pages) will include papers and reports submitted to the Section of Hydrology. The many requests being received from geophysicists in all parts of the world evidence the value of the "Transactions" in disseminating the progress of work done in America and in forwarding that international exchange of data and thought so essential to the science of geophysics and its steadily growing interpretation, utilization and application.

J. A. FLEMING,
General Secretary

WASHINGTON, D. C.

SPECIAL ARTICLES

A CURVE OF EXPERIMENTAL EXTINCTION IN THE WHITE RAT

PSYCHOLOGICAL studies present many examples of curves which show the progress of forgetting as a function of the time which has elapsed since learning was completed. There are, however, very few graphic representations showing the progress of the experimental extinction of a conditioned response as a function of the time which has elapsed since the completion of conditioning.

Kleitman and Crisler[1] present extinction curves, parabolic in form, for the salivary reflexes of three dogs. The curves show a decrease in the quantity of secretion, with an increase in elapsed time. Skinner[2] has studied extinction in the rat under conditions where food is the reinforcing agent and where the frequency of response is determined by the rat and not by the apparatus, as is usually the case. An inspection of his curves indicates that there is a progressive wave-like decrease in the frequency of the conditioned response during a one-hour period when no reinforcement is given. Switzer,[3] in a study of the galvanic skin reflex (GSR), studied the progress of experimental extinction to the point where two or three conditioned stimulations failed to elicit the conditioned response. The extinction curve is presented in the form of a Vincent curve, showing the decrease in the magnitude of the GSR in successive tenths of the extinction period. This curve is essentially linear, and therefore differs markedly from the curve of Kleitman and Crisler and also from such typical forgetting curves as those of Ebbinghaus and Ballard for verbal responses. It should be pointed out, however, that the usual forgetting curves (and those of Kleitman and Crisler and of Skinner) are not Vincent curves representing the amount forgotten, or eliminated, during successive equal parts of the total forgetting time; rather the usual forgetting curves represent the average amount of retention (or elimination) after selected periods of elapsed time. Further note should be made of the fact that Piéron[4] holds the sudden initial drop in the Ebbinghaus curve to be an artifact. Hilgard and Marquis,[5] working with the conditioned eyelid response in the dog, found that the frequency and amplitude of the response decreased during experimental extinction. The percentage frequency of response plotted against time gives a gradual almost linear decrease of frequency.

Although Hull[6] cautions against identifying forgetting and experimental extinction, nevertheless something can be said for an attempt to relate these

[1] N. Kleitman and G. Crisler, *Amer. Jour. Physiol.*, 79: 571–614, 1927.

[2] B. F. Skinner, *Jour. Gen. Psychol.*, 8: 114–129, 1933.

[3] St. C. A. Switzer, *Jour. Gen. Psychol.*, 9: 77–100, 1933.

[4] H. Piéron, *L'année psychol.*, 19: 91–193, 1913.

[5] E. R. Hilgard and D. G. Marquis, *Jour. Comp. Psychol.*, 19: 29–58, 1935.

[6] C. L. Hull, "Learning: the factor of the conditioned reflex," in "Handbook of general experimental psychology," p. 438. Worcester, Mass.: Clark University Press, 1934.

two phenomena. (Thus my own work[7] reveals a correlation between conditioning and extinction of the same order as that found between the learning and forgetting of verbal responses.) To what extent the underlying process in extinction and forgetting is the same remains to be determined. The two phenomena are produced under (or by) different experimental conditions, and yet each represents a progressive loss in the capacity to respond, a loss which can not be accounted for by such factors as fatigue. It is a worthy hypothesis that during the extinction period the subject is essentially learning *not* to respond to the conditioned stimulus. The relative incompleteness of this learning, plus the great prepotency of the unconditioned response, would then offer a basis for the "spontaneous" recovery of the conditioned response. Such a hypothesis is not contradictory to the view that experimental extinction is an inhibitory process; and the hypothesis is in harmony with the view, currently held in much favor, that forgetting is a result of activity interpolated between the end of the learning period and the beginning of the retest period.

The present experiment was carried out on 21 previously untrained white rats. These animals, blinded 24 hours prior to the experiment, were conditioned to run in response to a buzzer. The apparatus used and the general procedure are outlined in an earlier issue of this journal,[8] and a more detailed description of experimental conditions is given elsewhere.[7] The general procedure was to present the buzzer once per minute, followed 2 seconds later by an induction shock *unless* the animal responded to the buzzer by running approximately a distance of 4 inches. The response might be greater than this, but smaller responses were not recorded, since they were usually mere twitches of the animal's body. A record was kept of the approximate distance that the animal ran to each buzzer stimulus during conditioning and extinction. An examination of these records indicates that the responses rarely exceeded a distance of 8 inches. The usual run was about 4 inches, enough to take the animal from one grill to another in the apparatus. Occasionally a run clear around the circular apparatus, some 32 inches, was made. During conditioning and extinction there was no progressive change in the magnitude of the runs.

The sequence of buzzer and (possible) shock was continued until the rat had made at least a 4-inch response for 10 successive presentations of the buzzer. (With the method here used, this would mean 10 conditioned responses without reinforcement.) The buzzer then continued to be sounded, without reinforcement at any time, until the rat failed to make an adequate response for 5 successive stimulations, at which time the arbitrarily set standard of extinction was reached. The total period of extinction thus extended from the beginning of the first 10 successive conditioned responses through the last of the 5 presentations of the buzzer which elicited no adequate locomotor response. (During these 5 trials, the rat almost invariably sat still, although it might show head movements to the buzzer.) Conditioning and extinction were accomplished in one experimental period without removing the animal from the apparatus. For the 21 rats, the average period of extinction was 79 minutes, sigma 35 minutes, range 16–139 minutes.

Fig. 1 presents Vincent curves for the extinction of the present conditioned response.[9] Curve 1 shows

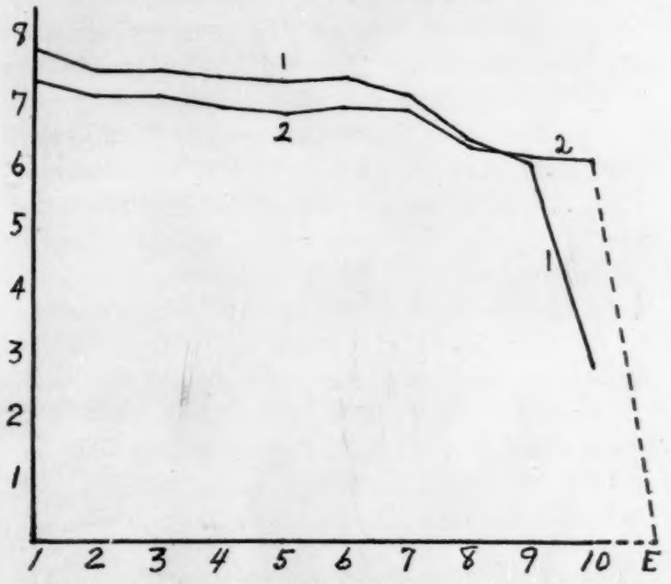

FIG. 1. Vincent curves for extinction of a conditioned locomotor response. The ordinate values are numbers of responses. The abscissa values represent tenths of the extinction period. *E*, for Curve 2, is the point at which no responses were made for 5 successive trials. The curves are described further in the text.

the average frequency of the conditioned response for tenths of the entire extinction period, *including* the last 5 trials when the rats sat still. Curve 2 excludes these last 5 trials and therefore represents the course of extinction up to the point where no response was made. The dotted portion of this curve indicates that, after the period of extinction, the rats suddenly ceased making locomotor responses to the buzzer. (The curves are derived from the 21 individual Vincent curves.) The unusual feature of these graphs is the sudden drop at the end, indicating the sudden elimination of the conditioned response. During the

[7] W. S. Hunter, *Brit. Jour. Psychol.* (in press).
[8] W. S. Hunter, SCIENCE, 81: 77–78, 1935.
[9] For comparable Vincent curves of the acquisition of the present conditioned response, see W. S. Hunter, *Jour. Exper. Psychol.* (in press).

period of extinction, the rats continued to run in response to the buzzer with a high degree of consistency until a point was reached where, relatively suddenly, no such responses were made. Inasmuch as the individual Vincent curves have essentially the same form found in the average curves, and inasmuch as the raw data reveal the same sudden termination of the conditioned response, the genuineness of the phenomenon seems well attested.

The extinction curves presented by Kleitman and Crisler and by Switzer are based on the magnitude of the conditioned response and not upon its frequency. Does the present conditioned locomotor response suffer a diminution in magnitude during the period of extinction so that the rat finally and gradually reaches a point where no movement is made to the buzzer? The present apparatus with its circular pathway permitted runs varying in magnitude from zero to an indefinitely large value. An examination of the records, however, shows that, although the lengths of the runs varied, there was no trend toward shorter and shorter runs. A curve relating the magnitude of the response to the amount of elapsed time would, therefore, have essentially the same form as the present curves, based on frequency of response. The suggestion is therefore apparent, from a comparison of the various curves found in the literature, that there is no one type of curve for extinction. Rather the character of the curve will depend upon many factors, including the type of response conditioned.

WALTER S. HUNTER

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DISSOCIATION OF THE PYRAMIDAL AND EXTRAPYRAMIDAL FUNCTIONS OF THE FRONTAL LOBE

SECTION of one pyramidal tract below its last large supra-segmental connection with the pons produces in cats a syndrome of deficit describable either as the specific reactions lost or impaired, or as a depression of phasic activity in general; or as a loss of excitation at the final moto-neurones in the cord. Spasticity, or other evidence of release, is absent. Stimulation of the motor cortex either immediately or months after such a section demonstrates the preservation within that cortex of inhibition, effective on tonic or clonic states present in the limbs, together with the abolition of the familiar motor function. An extrapyramidal type of motor activity is at the same time uncovered.

Repetition of this lesion in rhesus monkeys produces a similar, though graver syndrome of deficit, again without spasticity. And again, stimulation of the cortex brings inhibition to bear on activity present in the limbs after destruction of the characteristic motor responses of the precentral gyrus. In the monkey, however, this inhibition is not confined, as in the cat, to the immediate motor region but is exercised by motor, premotor and prefrontal cortex, and from the second of these, most vigorously. From this region, for instance, tonic closure of the fingers into a grasp is most easily released. Moreover, although the fine type of movement characteristic of stimulation of the precentral gyrus is totally abolished by the lesion, the so-called adversive movements survive, and can be elicited not only from the premotor region but from the precentral and postcentral gyri, as well. Furthermore, after section of one or both pyramidal tracts at the level of the trapezoid body, with or without time for degeneration, epileptiform convulsions are easily set in train by stimulation of the motor, premotor and prefrontal regions, and even of spots in the parietal lobe. These involve all four limbs and face, show typical progression, tonic and clonic phases and after-exhaustion, resembling in essentials the clinical Jacksonian seizure.

One may conclude, therefore, that pyramidal and extra-pyramidal functions of the motor cortex and adjacent regions may be dissociated by pyramid section. The rapidly executed, fairly discrete movements, long familiar from cortical stimulation, are thus demonstrated to be mediated exclusively by the cortico-spinal tract. On the other hand, the integrity of this tract is not necessary to the exhibition of the larger movements called adversive, nor to the exercise of the very important inhibitory function of the cortex. Consequently, these, together with the epileptiform convulsions elicited, represent extrapyramidal activities of the cerebral cortex.

SARAH S. TOWER
MARION HINES

THE JOHNS HOPKINS UNIVERSITY

THE NATURE OF THE BARBITURATE-PICROTOXIN ANTAGONISM[1]

MALONEY, Fitch and Tatum[2] and Maloney and Tatum[3] have shown that picrotoxin is a very effective antidote in acute barbiturate poisoning. We have had ample occasion to confirm their data in animals poisoned with large doses of intravenously administered barbiturates. Quoting only extreme cases, the results in Table 1 were obtained:

To a number of dogs and rabbits, we administered the minimum anesthetic doses of different barbiturates, waited for the onset of anesthesia and then recorded

[1] From the Department of Pharmacology and Materia Medica, Georgetown University, School of Medicine, Washington, D. C.

[2] Maloney, Fitch and Tatum, *Jour. Pharmacol. Exper. Therap.*, 41: 465, 1931.

[3] Maloney and Tatum, *Jour. Pharmacol. Exper. Therap.*, 44: 337, 1932.

TABLE 1

Animal	Drug	Total dose of barbiturate. mgm per kgm	Total dose of picrotoxin mgm per kgm	Time
Dog	Sodium barbital	1,650	20	Died in 1½ hrs.
Dog	Sodium phenobarbital	375	6	Died in 2 hrs.
Dog	Sodium pentobarbital	160	38	Died in 68 min.
Dog	Sodium pentobarbital	100	18	Recovered in 12 hrs.
Rabbit	Sodium pentobarbital	100	24	Recovered in 5½ hrs.

the animal's respiration and carotid blood pressure on a kymograph tracing. While the animal was thus under constant observation further doses (usually ¼ of the M.L.D. was used for a single injection) of the barbiturate originally administered were given intravenously. It was observed that these injections produced in each instance a sharp fall in blood pressure and a slowing or stoppage of respiration. The blood pressure fell after each additional injection. Death was due to a combination of circulatory collapse and respiratory failure.

The antidotal effect of different doses of picrotoxin was manifested in four different ways: (a) Occasional rise in blood pressure; (b) prevention of the steep fall in blood pressure and hastening the recovery from the fall produced by intravenous barbiturate injection; (c) stimulation of respiration when stoppage was produced by barbiturates; (d) maintenance of respiration after barbiturate injection even after cardiac stoppage.

In several experiments, it was noticed that the action of small doses of adrenaline and ephedrine was especially marked following picrotoxin in the barbitalized animals. These drugs not only stimulated respiration with a simultaneous rise in blood pressure, but the hemodynamic effects they produced after picrotoxin was more pronounced and more sustained than in controls. In several cases, intravenous injections of adrenaline (a total of 0.1 cc of 1 to 20,000 solution) produced a gradual and sustained rise in blood pressure. These sustained rises with adrenaline and ephedrine may be explained as shifts in blood volume. Adrenaline and ephedrine then may be employed as effective antidotal agents together with picrotoxin in barbiturate poisoning and possibly in other instances of circulatory collapse and respiratory failure.

CHARLES R. LINEGAR
JAMES M. DILLE
THEODORE KOPPANYI

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PHYSIOLOGICAL STROBOSCOPE

IN SCIENCE for December 21, 1934, the authors described their physiological stroboscope and its application in the field of the mechanics of phonation. Refinement of the apparatus and the addition of cooperative instrumental units has followed the study of the stroboscope with a model larynx as the subject.

The heart of the instrument is a specially designed amplifier fed by a wide-frequency-range microphonic element. It was a simple step to add to the gaseous discharge lamp in the output a cathode ray oscillograph and a recording device with audio monitor. The chain of instrumental response is currently as follows: A tone originating in the artificial larynx is passed to the microphonic element and into the amplifier, where its electrical component is linearly increased in amplitude; thence into the amplifier's phasing and band pass filter section, where a reduction of the origin tone to its fundamental frequency is achieved and translated in the output into a flashing of the gaseous discharge lamp at a period synchronous with the frequency of the tone emitted by the artificial larynx. Simultaneously, as the lamp held near the vibrating cords of the larynx reveals them in stroboscopic immobility, the fluorescent screen of the cathode ray oscillograph exhibits a wave analysis and the recording device registers and monitors the tone produced by the cordal configuration under observation.

With this apparatus revealing for the first time the tonal conformation of the cords during frequency transitions, and with a visual representation of the sound thus produced, a relationship is postulated wherein a particular tone is reproducible by the reestablishment of a predictable set of mechanical conditions in the larynx. Thus the isolation of individual factors responsible for vocal characteristics is accomplished.

Further study and interpretation of the apparatus operative with the artificial larynx will precede any report of observations made on clinical cases.

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H. S. POLIN

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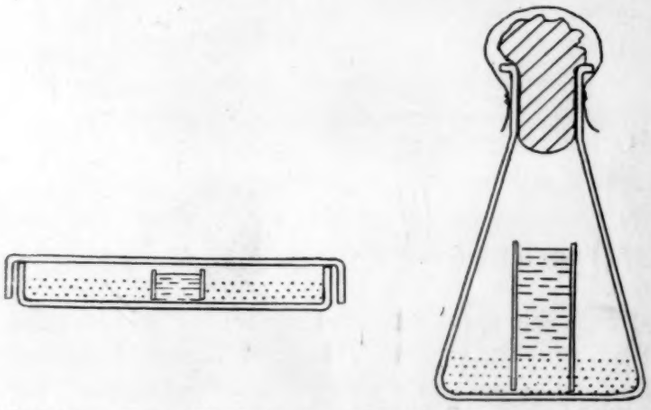
A METHOD FOR IRRIGATING FUNGUS CULTURES

AN adequate study of smaller fungi must always include careful pure-culture work. Information re-

garding various types of fructification can be better secured by observing their development in Petri dish cultures rather than in flask or tube cultures. However, the rapidity with which the substratum dries in cultures of the former type often proves a serious handicap in the study of those species which require long periods of time to complete their life history. This is often true of plates kept at 20° to 22° C., but more often of those incubated at higher temperatures. There has been need of a method for renewing the supply of moisture in the medium without disturbing the growth of the fungus. Such a method would make it possible to continue cultures over a long period of time without either an injury from drying or a disarrangement of conidial fructifications by adding water to the surface of the agar. The following method has been used with good results.

A van Tieghem ring is enclosed in the Petri dish and the two are sterilized together. The ring is easily centered by lightly shaking the dish just prior to pouring the medium. The liquid agar is poured around the ring, spread over the surface of the dish and allowed to harden. The ring thus becomes an empty glass well in the center of the plate (Fig. 1).



FIGS. 1 and 2. Methods for irrigating fungus cultures.

After inoculation and the growth of the fungus, the well is filled with sterile water by means of a sterile pipette before the agar shows any visible sign of drying. From under the lower edge of the ring the water slowly seeps out into the agar, diffusing through the entire plate. This irrigation may be repeated as often as desired, and the life of a single plate culture may thus be greatly prolonged. Since humidity requirements vary with different cultures, a sterile glass cover slip may be placed over the top of the well if it is desirable to prevent too rapid evaporation. If a cover is used it must be so placed as to leave a very small space between its edge and the side of the well, where air may enter as water recedes.

Inoculations are made either at several points immediately outside the glass well, or a continuous circular streak is made with a wire loop carrying a suspension of spores in sterile water.

Van Tieghem rings, sometimes listed as culture rings, vary in size and thickness of glass. Good results have been obtained by using a ring ten millimeters high by eighteen to twenty millimeters in diameter, of glass less than one millimeter thick. The usual ring of thicker glass is more easily lifted from the bottom of the dish by the fluid agar, which then spreads under it, raising the well, and thus opening a wider channel for water seepage. In the case of cultures requiring a very moist substratum this may be desirable; however, for many a culture a slower seepage is to be preferred.

This well can also be used for experiments in nutrition. The acid content of the culture may be altered, or the increasing acidity may be checked. To maintain the purity of any culture a fresh sterile pipette must be used for each irrigation.

Cultures in Erlenmeyer flasks may be similarly irrigated through a piece of glass tubing 18 to 20 millimeters in diameter, inserted into the middle of the agar before it is autoclaved. The length of such tubing must be carefully adjusted to prevent aerial hyphae or fructifications which grow on the sides and the upper edge of the tube from coming into contact with the plug. A two-inch length of tubing is suitable for a flask four inches in height. These flask cultures should be capped with heavy waxed paper or with heavy composition foil before they are sterilized; and all subsequent handling of the plugs should be done without removing this cap from the cotton. This prevents foreign conidia from infecting the plug, which often offers them an ideal chance for germination, and for contaminating growth into the culture below.

DOROTHY PEASE

BROOKLYN COLLEGE

BOOKS RECEIVED

BENGSTON, NELS A. and WILLEM VAN ROYEN. *Fundamentals of Economic Geography.* Pp. xxviii + 802. 300 figures. Prentice Hall. $5.00.

COPSON, E. T. *An Introduction to the Theory of Functions of a Complex Variable.* Pp. 448. Oxford University Press. $8.50.

FISHBEIN, MORRIS, Editor. *Modern Home Medical Adviser.* Pp. xxxi + 905. 136 figures. Doubleday Doran. $9.50.

POTEAT, WILLIAM L. *Stop-Light.* Pp. 91. Broadman Press, Nashville. $0.75.

SCHUCHERT, CHARLES. *Historical Geology of the Antillean-Caribbean Region.* Pp. xxvi + 811. 107 figures. Wiley. $10.00.

TILDEN, JOSEPHINE E. *The Algae and Their Life Relations: Fundamentals of Phycology.* Pp. xii + 550. 257 figures. Oxford University Press, London, and the University of Minnesota Press. $5.00.

WILLIAMS, FRANCIS H. *Radium Treatment of Skin Diseases, New Growths, Diseases of the Eyes and Tonsils.* Pp. iii + 118. Illustrated. Stratford. $2.00.